

## 10.6 Expected Value

### Part 1 – Insurance Premiums

When you purchase a homeowners insurance policy, you pay a certain amount of money (the premium) to the insurance company. If nothing happens to your home, the insurance company keeps the money. If you make a claim, the company will pay to fix your home, usually spending a lot more than what your premium was. Due to this set up, the insurance company makes money on some policies and loses money on others. In this activity, we will investigate the way an insurance company computes insurance premiums.

Suppose that in a certain neighborhood, an insurance company has used historical data to determine that the probability of a house fire occurring at a home over the course of one year is 0.02%.

1. What is the probability that there will not be a fire at a house in the neighborhood over the course of one year?

Assume that the insurance company charges a \$300 annual premium for fire insurance. If there is a fire, the insurance company will pay out \$200,000 to the homeowner.

2. Fill in the table below (from the insurance company's perspective).

Probability and Payout for Insurance Company		
Event	Probability	Payout – Premium
Fire		
No Fire		

3. Determine the expected value that the insurance company will pay out.
4. What does the expected value say about the average loss or gain for the insurance company on each policy they sell?
5. How much would the insurance company expect to earn on average if it sold 10,000 policies in a year?

## Part 2 – Betting

Let's begin with a lesson in roulette. Setup of wheel:

- 38 numbers total
- 18 red
- 18 black
- 2 green



We make the following bet:

- **Bet on a single number:** Win \$36 for every \$1 bet. For example, if we bet \$1 and win, we get \$36; if we lose, we lose our \$1.
1. Calculate the probability that we will win on a single spin of the wheel. Calculate the probability we will lose.
  2. What is the expected value of the bet described above (betting on a single number)?
  3. Create a probability table for a \$5 bet.
  4. What is the expected value for the bet in #3?

Now suppose we are playing a lottery (raffle ticket) where we can win the following amounts of money with the corresponding probabilities.

\$ Payout	P(Payout)
0	0.5899
5	0.2
10	0.15
15	0.05
20	0.01
100	0.0001

5. Find the expected value of the payout for this game using your calculator.
6. If tickets for this lottery cost \$4, should you expect walk away with money (net gain) if you buy 100 tickets?